CLIMATOLOGICAL DATA FOR MAY, 1911.

DISTRICT NO. 10, GREAT BASIN.

ALFRED H. THIESSEN, District Editor.

GENERAL SUMMARY.

May, 1911, was a cool, windy month, with an unusual lack of moisture. The season was backward, probably two or three weeks. The wind movement was greater than the average, drying vegetation and the soil rapidly, and also injuring leaves of plants in places by blowing sand against them. Compared with May of 1910, it averaged 5° colder, but the precipitation was somewhat heavier.

No severe atmospheric disturbance passed over the Great Basin during the month; but a storm center settling over western Colorado on the 10th, followed by an area of high pressure then covering the entire Northwest, caused frost conditions, which were more or less severe throughout the district. Alfalfa was frozen, potato vines nipped, early beets, strawberries and other garden truck were damaged as well as some fruit, especially apples.

There was an unusually large number of thunderstorms, especially in Nevada, but they were, as usual at this season, very mild.

The average number of rainy days was 3; clear days, 13; partly cloudy days, 10; and cloudy days, 8.

TEMPERATURE.

The temperature for the district averaged 52°, which is about 2° below normal. The mean temperature at the various stations ranged from 39.4° at Tahoe, Cal., to 72.8° at Jean, Nev. The highest means occurred in the sheltered valleys of Utah and in southern Nevada; and the lowest in parts of the Oregon and California areas.

Most stations in the district reported monthly mean temperatures below normal; and in most cases where mean monthly temperatures above normal occurred, the departures were small. The greatest deficiences occurred in central Nevada, with −9.5° at Battle Mountain; the greatest excess was 3.3°, at Mount Nebo, Utah.

The first two days of the month were cool, a few stations reporting their lowest temperatures on those days. A period of warm weather prevailed from the 3d to the 5th, inclusive, when some stations reported the highest temperatures for the month, notably Iosepa, Utah, where the maximum thermometer registered 100° on the 5th. After this date temperatures fell steadily until the 10th, when killing frosts occurred. The weather grew warmer after the 11th, and nearly normal temperatures were recorded for the remainder of the month, with the exception of the 25th and 26th, which were unusually cool, and freezing temperatures were reported at several stations.

The highest temperature for the month was 100°, at Iosepa, Utah, on the 5th and 25th, the next highest being 93°, at Jean, Nev., on the 21st. The lowest temperature was 12°, at Ibapah, Utah, on the 26th, the next lowest being 13°, at Cliff, Oreg., on the 13th.

PRECIPITATION.

The May precipitation averaged 0.66 inch for the district, which is 0.79 inch below normal. Considering only those stations with long records, but two reported amounts above normal. The chart of precipitation shows the usual regional variations, but small areas exhibited widely different amounts as well, indicating the usual summer characteristic.

The largest amounts of precipitation were recorded on the western slopes of the Wasatch Mountains in Utah, in central Nevada, and at a few stations in the California area. The greatest amount reported from any station was 1.84 inches at Salt Lake City, Utah, while no precipitation occurred at several stations.

In the Oregon and California areas light showers fell daily from the 1st to the 18th, but they were not general except on a few days. There were a few showers in the last decade of the month in those areas, being general in the California area on the 29th and 30th. The rainfall for the remaining portion of the district shows the usual distinguishing feature of summer rains in this region; that is, light showers on various dates. The larger portion of the rain, however, fell from the 9th to the 19th, and on the 25th and 26th.

WHERE THE SNOW LIES IN SUMMER.

By J. CECIL ALTER, Observer.

Contrary to popular supposition, the snow that clings to the mountain sides throughout the summer and keeps the irrigation streams running steadily in August and September, is not hidden in the cool shadows of the forests, but lies out in the open, where the summer sun and the mountain winds may attack it freely.

Generally in the Rocky Mountains the snow disappears, as a cover, up to the 8,000-foot contour in April or May, receding to the 10,000-foot level by June, and by the 1st of August even the crests are usually bare. The only snow remaining lies in patches, and this, with the moisture already absorbed by the ground, forms the subsequent stream supply.

These limited regions of snow have naturally more the consistency of ice than of snow, ranging from 50 to 75 per cent of the density of water, sometimes containing 85 per cent, otherwise they could not long endure the constant winds and the almost uninterrupted summer sunshine of the Rocky Mountain region.

As a rule these icy stores of snow are more numerous on the north and west slopes though not in places entirely obscured from the sun. Usually less snow falls on the south and east slopes, because nearly all Rocky Mountain storms come from the west or northwest, and deposit most of their moisture on the windward sides of the mountains. The snow that does fall on the southerly slopes receives the more direct rays of the sun and is frequently melted before the following storm, even in winter.

On the freely exposed northerly slopes, where the snow deposit is much greater than on the south, the slanted rays of the sun melt it more slowly, serving chiefly to soften it; and the steady, strong winds, which often have a temperature well above freezing, settle it gradually, and with the aid of frequent freezing temperatures at night the snow deposits gradually assume the characteristics of small glaciers, which are formed in the depressions by gravity, under the unshaded sun's rays.

well soaked, small streams at times appear on the surface, but as a rule the water from a great many drifts is required to form the stream that has a good steady flow all summer long. These occur on the broader mountain slopes in practically all parts of the Rocky Mountains north of the Grand Canyon.

Practically all the streams that head as high as 10,000 feet carry water to the irrigated farms, or to other outlets, all summer, though usually the volume is much diminished in late July, August, and September. Some watershed slopes are so porous that the stream is lost through seepage; and nearly all the smaller streams dry up in midsummer, as they are fed by snow deposits on the lower, usually flatter, slopes where the accumulations have been less.

Trees carrying 5 inches of moist snow, Mormon Temple block, Salt Lake City, Utah. Photo. by C. R. Savage.

When snow falls, there are usually high, driving winds in the mountains that carry the snow into the hollows and ravines, leaving the crests and rounded tops but thinly covered, if covered at all. After the storms are over the wind and the sun assist gravity in solidifying the deposit, and the precipitation from subsequent storms, which is frequently similarly distributed if in the form of snow, increases the weight in the hollows. In addition heavy rains are not at all unusual, and these make the snow deposit very hard and heavy.

As summer advances the surface layers melt slowly and the water trickles gently away, often serving only to moisten the soil below the snow pack. However, from the larger drifts, and where the mountain side is

When there is no warm weather in winter, favorable for packing and solidifying the snowfall in the sunny hollows, the snow supply may be seriously depleted during the early spring run-off, and in late summer even the longest streams may go dry under such circumstances.

Over forested regions no more snow falls than elsewhere with similar topographical exposures, but the falling snow is caught by the millions of branches on the trees, and much of it never reaches the ground but is evaporated from the swaying limbs. This often occurs while temperatures are below freezing, as evaporation from snow, while it is usually a slow process, is in this case hastened by the much greater surface exposure to the drying breezes.

It has been observed in well forested regions that a downfall of 4 or 5 inches of snow may be almost entirely supported by the branches of the evergreen trees, even when deposited in a high wind, provided the snow was sufficiently moist when it fell. In such cases a subsequent freeze may attach it firmly to the branches. Since nearly all heavy snows come during only moderately cold weather and often actually begin as rain, the amount of moisture that clings to the trees to be subsequently evaporated is very great. It has been variously estimated at from 50 to 80 per cent of the fall of snow, under the varying conditions that exist over the forest.

In the forest openings the snow depth is something near what the depth would be if there were no forest or high winds, but the influences that tend toward solidifying it are handicapped by the forest surroundings, and, being loosely stored, the snow is in less favorable condition for long keeping. It is not unusual in late winter to see in a forest acres of bare ground under the trees, and just beyond the limits of the boughs of the outside trees to see snow a foot or two in depth lying generally over the unforested slopes.

Seldom a winter passes without warm periods, and tremendous mountain floods may occur as a result of long-continued warm, southerly winds, and much sunshiny weather, followed by a general, heavy rain. At these times the loosely deposited snow in the forested regions is carried quickly away, reaching the waterways before the more solidly packed snow elsewhere is melted, although this also disappears with great rapidity. The only snow that can long withstand these winter thaws is that which has been solidly packed in the swales, pockets, and hollows by the cumulative and gradual influences of the sunshine, the wind, and the winter rain. And for such snow packs as these, the late summer irrigator is duly grateful.

There has been a great deal of discussion about the influence of forests on the run-off from watersheds, and the retention of water for late summer use.

A number of scientific men have expressed the opinion that the slopes and unarable valleys should be reforested so as to minimize flood conditions, which, they allege, are intensified by the lack of forest cover to delay the melting of the snow and impede the flow of that already melted. However, the best evidence obtainable at present seems to support the ideas of Prof. Willis L. Moore, Chief of the Weather Bureau, that—

> The rugged mountain slopes and tops, where land has little value, are unimportant as flood producers; * * * the forests should be preserved for themselves alone, or not at all. * * * A flood in any given stream is usually caused by the precipitation over its entire watershed * * * and is affected but comparatively little * * * by the precipitation over the extreme upper reaches, usually the forested areas.

The claim that late irrigation would be crippled by the removal of the forests or benefited by reforesting large areas would also appear to be erroneous, as the late summer irrigator gets his water principally from the snow

Snow fields at Lake Martha, Wasatch Mountains, Utah, early August, 1910. Elevation, 11,000 feet; looking east-southeast. Photo. by Shipler.

packs that lie out in the open, solid from the effects of the sunshine, wind, and rain, the softer snow in the forests and other shady places having disappeared in April, May, or June.

ORCHARD HEATING.

By ALFRED H. THIESSEN, Section Director.

GENERAL.

On a recent visit to Grand Junction, Colo., the writer had an opportunity of studying methods of frost fighting as carried on in the Grand Valley. This valley has 20,000 acres in fruit trees and 10,000 in bearing, reaching from Palisade to Fruita. The valley is similar to a huge trough, bordered, as it is, on each side by high mesas. This natural conformation assists the growers immensely in their frost-fighting campaigns, lessening the strength of the wind, moderating the temperatures, and forming a pocket to hold the smoke generated by the heaters.

ORGANIZATION.

The one thing that makes orchard heating so effective in the Grand Valley is the close cooperation which exists between the growers, the chamber of commerce, and the local office of the Weather Bureau at Grand Junction. The fruit section is divided into districts, and a grower who owns an orchard representative of his district acts as weather observer. On nights of expected frost the local office of the Weather Bureau remains open all night to receive hourly and sometimes half-hourly readings from thermometers exposed throughout the fruit section and to send out warnings, if necessary. By this system the worry of watching for frost devolves on only a few trusted observers, who by their self-sacrifice make it possible for the majority of the growers to rest quietly.

On nights when heating is necessary, a great deal of assistance is required by the farmers. To aid them, the town people offer their services gratuitously. In order to distribute this help quickly the chamber of commerce keeps a card list of farmers desiring aid, and details certain helpers to certain farmers. The volunteers are taken to the orchards in all manner of conveyances—buggies, wagons, automobiles, and interurban and railroad cars—the owners of which freely contribute their use for the general good.

When frost is expected, the fruit growers' association and the local office of the Weather Bureau work harmoniously together, and the temperature conditions over the entire valley are carefully watched. This detailed supervision is necessary, owing to the fact that at times it has been found needful to heat one section and not another, a difference of several degrees frequently existing between the warmest and coldest parts of the district; and these conditions may on other occasions be reversed—the coldest part one night may be the warmest part on another.

Watchfulness and preparedness are the keynotes of success. Sometimes only one or two districts are in danger; at other times the entire section is warned. Warnings are sent from the Weather Bureau office to the secretary of the chamber of commerce, who requests the telephone operators to awaken the growers in the endangered district, and the work of firing is begun at once. To quote the Weather Bureau official at Grand Junction:

> As if by magic the entire district becomes a blaze of light overhung by a pall of fiery red smoke clouds. The heat produced is regulated by varying the number of pots lighted per acre and through changing, by means of covers, the size of the flames from the individual pots. From a distance the scene reminds one of fairyland. Within the orchards, among the smoke and smell, a lurid glare lighting up the trees, move the fleeting figures of the smudgers poking the flaming, sizzling pots, and one might imagine the purpose of the operation one of evil rather than good.

In order to work so quickly, all growers who intend to heat prepare to the last detail. Before the frost period begins pots are set out between the trees, placing them slightly to one side of the center to provide a passageway for a team, and filled with oil or with kindling and coal. All over the orchard in handy locations lie piles of coal ready for the recharging process as soon as the fires begin to get low. Oil wagons filled with oil are also in readiness to be hauled into the orchards to refill the pots when necessary. The growers in the Grand Valley believe in firing long after sunrise.

MATERIAL.

All kinds of orchard heaters are used, burning either oil or coal, although occasionally, if a grower has accumulated a large quantity of brush, prunings, or the like, he will pile it to windward of his orchard and burn it.

The fruit growers' association buys crude oil direct from the refineries at $0.035 per gallon and sells it to the grower at $0.0482—just enough in advance of the purchase price to pay for handling it. Many growers own 600-gallon tank wagons in which they haul oil to their farms, where it is stored in large steel or cement tanks.

Coal is sold to the growers at prices ranging from $2 to $2.75 per ton. Some growers are located very near mines, and buy direct from them.

RESULTS.

The question of whether it pays or not to fire an orchard is one which can not be easily answered offhand. Of course, one can easily see that a grower may fire so many times that the amount of money realized from the fruit saved will not pay for the fuel, extra help, and deterioration of his heaters. This question is complicated by the varying market conditions. In general the growers are enthusiastic over the results of orchard heating, but there are always a few growers in all sections who do not believe in it.

PROBLEMS IN CONNECTION WITH ORCHARD HEATING.

The question as to just what temperature will kill a bud, blossom, or fruit is a very complicated one, and I doubt whether it can be answered without giving many qualifications. The killing temperatures will vary with the stage of advancement of the fruit, the previous treatment of the tree, the character of the previous season, the length of time that the fruit is subjected to certain temperatures, and other influences more or less important.

If the killing temperature for fruit at any particular stage can be given, then the grower has an inkling when to fire. Observations of the temperature of the air are, however, not good indications of the temperature of the buds; other meteorological conditions vary the relation. The temperature of a bud surrounded by clear, dry, calm air at 32° may be quite different from that of one enveloped by moist, moving air at the same temperature but with a cloudy sky.

At present it seems best, with a condition of falling temperature and a fair assurance that a killing tempera-